Q.C.

BECKMAN

HAND-HELD DIGITAL MULTIMETERS SERIES 300, SERIES 3000, AND HD SERIES

SERVICE MANUAL

HAND-HELD DIGITAL MULTIMERS

SERIES 300, SERIES 3000,

AND HD SERIES

SERVICE MANUAL

BECKMAN INDUSTRIAL CORPORATION
Manufacturer of Doric Instrumentation
A Division of Emerson Electric Company
630 Puente Street • Brea, California 92621

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SECTION ONE

GENERAL INFORMATION

1 INTRODUCTION

The Series 300, Series 3000, and Series HD Digital Multimeters are a group of portable 3½-digit multimeters designed for use by the engineer, technician, or hobbyist. Each of the wide variety of functions and ranges available is quickly and easily selected with the turn of a single selector switch. The portability and accuracy of these instruments make them equally well suited for design engineering, production testing, field servicing, and industrial maintenance applications

2 SPECIFICATIONS

Accuracies are ±(% of reading + no. of digits). Guaranteed for one year, 25°C ±5°C

DC Voltage	**HD-100**	**HD-110**
Ranges	±200mV, 2V, 20V, 200V, 1500V	
Resolution	100μV on 200mV range	
Accuracy	0.25% rdg. + 1	
Input Impedance	22MΩ, all ranges	
Normal Mode Rejection	>60 dB above 49Hz	
Common Mode Rejection	>140 dB up to 1500Vdc	
Response Time	Less than 1 second	
Overvoltage Protection	1500Vdc or peak ac, any range	
AC Voltage	**HD-100**	**HD-110**
Ranges	200mV, 2V, 20V, 200V, 1000V	
Resolution	100μV on 200mV range	
Accuracy—45Hz- 2kHz 2Hz- 5kHz 5Hz-10kHz	0.75% rdg. + 3 1.50% rdg. + 5 2.50% rdg. + 9	
Conversion Type	Average sensing—RMS calibrated sine wave	
Input Impedance	2.2MΩ shunted by <75pF	
Response Time	Less than 2 seconds	
Overvoltage Protection	1000Vrms/1500V peak ac or 250Vdc (5 sec. max above 450Vrms, 200mV range)	
Resistance	**HD-100**	**HD-110**
Ranges	200Ω, 2KΩ, 20KΩ, 200KΩ, 2MΩ, 20MΩ	
Resolution	0.1Ω on 200Ω range	
Accuracy—200Ω to 2MΩ Ranges	0.5% rdg. + 1	
20MΩ Range	1.5% rdg. + 1	
Maximum Open Circuit Voltage	500mV	
Maximum In-Range Voltage	250mV	
Maximum Test Current	2.5mA	
Response Time	Less than 1 sec., except 20MΩ range, less than 4 sec.	
Overload Protection	600Vdc or rms ac on any range	
Insta-Ohms Continuity Function	**HD-100**	**HD-110**
Response Time	<100 milliseconds	
Diode Test	**HD-100**	**HD-110**
Range	0 to 2V	
Resolution	1mV	
Accuracy	0.25% rdg. + 2	

Test Current	2mA, ±10%	
Response Time	Less than 1 second	
Overload Protection	600Vdc or rms ac on any range	
DC Current	**HD-100**	**HD-110**
Ranges	200μA, 2mA, 20mA, 200mA, 2A	200μA, 2mA, 20mA, 200mA, 2A, 10A
Resolution	100nA on 200μA range	
Accuracy—200μA to 2A Range	0.75% rdg. + 1	
Accuracy—10A Range	Not applicable	1.5% rdg. + 1
Response Time	Less than 1 second	
Voltage Burden	250mV max. at full scale except 2A range 700mV	200mV max. at full scale except 2A range 700mV, 10A range 250mV
Overcurrent Protection (A Input)	2 amps/600V (fused)	
Overcurrent Protection (10A Input)	Not applicable	Up to 20 amps for 30 seconds (unfused)
AC Current	**HD-100**	**HD-110**
Ranges	200μA, 2mA, 20mA, 200mA, 2A	200μA, 2mA, 20mA, 200mA, 2A, 10A
Resolution	100nA on 200μA range	
Accuracy—200μA to 2A Range—45Hz-2kHz	1.5% rdg. + 3	
Accuracy—10A Range—45Hz to 400Hz	Not applicable	2.0% rdg. + 3
Conversion Type	Average sensing	
Response Time	Less than 2 seconds	
Voltage Burden	250mV max. at full scale except 2A range 700mV	200mV max. at full scale except 2A range 700mV, 10A range 250mV
Overcurrent Protection (A Input)	2 amps/600V (fused)	
Overcurrent Protection (10A Input)	Not applicable	Up to 20 amps for 30 seconds (unfused)
General	**HD-100**	**HD-110**
Operating Temp.	0°C to +50°C	
Storage Temp.	−40°C to +65°C, battery removed	
Max. Common Mode V	1500Vdc or peak ac	
Display	3½-digit LCD (1999 max. count)	

Power	Single std. 9V battery, NEDA 1604
Battery Life	Alkaline: 2000 continuous hours typical— Zinc carbon: 1600 continuous hours typical
Low Battery Ind.	Decimal point blinks during last 200 hours of battery life
Shock & Vibration	Meets MIL-T-28800 specifications
Rel. Humidity	0-80%, 0°C to 35°C; 0-70%, 35°C to 50°C
Tempco	Less than 15% of applicable accuracy spec. per °C (0°C to 20°C, 30°C to 50°C)
Dimensions	7.2 in. L × 3.9 in. W × 2.0 in. H
Case Material	High impact, fire retardant, plastic
Weight	18 oz. (510g) including battery
Calibration	Accuracy specifications guaranteed for one year
Calibration Adj.	One
Measurement Rate	Four measurements per second, nominal

DC Voltage	**3000**	**3010**	**3010UL**	**3020/3020B**	**RMS 3030**
Ranges	±200mV, 2V, 20V, 200V, 1500V		±200mV, 2V, 20V, 200V, 750V	±200mV, 2V, 20V, 200V, 1500V	
Resolution	100μV on 200mV range				
Accuracy	0.5% rdg. ±1 digit	0.25% rdg. ±1 digit		0.1% rdg. ±1 digit	
Input Impedance	22MΩ all ranges				
Normal Mode Rejection	>60dB above 49Hz				
Common Mode Rejection	>140dB up to 1500Vdc		>140dB up to 750Vdc	>140dB up to 1500Vdc	
Response Time	Less than 1 second				
Overvoltage Protection	1500Vdc or peak ac any range		750Vdc or peak ac, any range	1500Vdc or peak ac, any range	
AC Voltage	**3000**	**3010**	**3010UL**	**3020/3020B**	**RMS 3030**
Ranges	200mV, 2V, 20V, 200V, 1000V		200mV, 2V, 20V, 200V, 500V	200mV, 2V, 20V, 200V, 1000V	
Resolution	100μV on 200mV range				
Accuracy 45Hz-2kHz 2kHz-5kHz 5kHz-10kHz 10kHz-20kHz	1.5% rdg. ±4 digits 2.0% rdg. ±5 digits 3.0% rdg. ±9 digits Not specified	0.75% rdg. ±3 digits 1.5% rdg. ±5 digits 2.5% rdg. ±9 digits Not specified		0.6% rdg. ±3 digits 1% rdg. ±5 digits 2.0% rdg. ±9 digits Not specified	0.6% rdg. ±4 digits 1% rdg. ±5 digits 1.5% rdg. ±6 digits 2% rdg. ±8 digits
Conversion Type	Average sensing—RMS calibrated sine wave				True RMS (ac + dc)
Input Impedance	2.2MΩ shunted by <75pF				
Response Time	Less than 2 seconds (on RMS 3030, above 10% of full scale)				
Overvoltage Protection	1000Vrms/1500V peak or 250Vdc (5 sec. max. above 450Vrms, 200mV range)		500Vrms/750V peak or 250Vdc (5 sec. max. above 225Vrms, 200mV range)	1000Vrms/1500V peak or 250Vdc (5 sec. max. above 450Vrms, 200mV range)	
Crest Factor*	Not applicable				1:1 to 5:1
Resistance	**3000**	**3010**	**3010UL**	**3020/3020B**	**RMS 3030**
Ranges	200Ω, 2kΩ, 20kΩ, 200kΩ, 2MΩ, 20MΩ				
Resolution	0.1Ω on 200Ω range				
Accuracy 200Ω to 2MΩ Ranges 20MΩ Range	0.75% rdg. ±1 digit 1.5% rdg. ±1 digit	0.5% rdg. ±1 digit 1.5% rdg. ±1 digit		0.2% rdg. ±1 digit 1.0% rdg. ±1 digit	
Maximum Open Circuit Voltage	500mV				
Maximum In-Range Voltage	250mV				
Maximum Test Current	2.5mA				
Response Time	Less than 1 second, except 20MΩ range, less than 4 seconds				
Overload Protection	500Vdc or rms ac at any range				
Insta-Ohms Continuity Function	**3000**	**3010**	**3010UL**	**3020/3020B**	**RMS 3030**
Response Time	Not applicable	<100 milliseconds			
Diode Test	**3000**	**3010**	**3010UL**	**3020/3020B**	**RMS 3030**
Range	0 to 2V				
Resolution	1mV				
Accuracy	0.5% rdg. ±2 digits	0.25% rdg. ±2 digits		0.1% rdg. ±2 digits	
Test Current	2mA, ±10%				
Response Time	Less than 1 second				
Overload Protection	500Vdc or rms				

*Crest Factor = $\frac{\text{Peak Voltage}}{\text{RMS Voltage}}$

DC Current	3000	3010	3010UL	3020/3020B	RMS 3030
Ranges	200μA, 2mA, 20mA, 200mA, 2A	200μA, 2mA, 20mA, 200mA, 2A, 10A			
Resolution	100μA on 200μA range				
Accuracy 200μA to 2A Ranges	1.0% rdg. ±1 digit	0.75% rdg. ±1 digit		0.35% rdg. ±1 digit	
10A Range	Not available	1.5% rdg. ±1 digit		1.0% rdg. ±1 digit	
Response Time	Less than 1 second				
Voltage Burden	200A to 200mA ranges: 250mV maximum at full scale. 2A and 10A ranges: 700mV maximum at full scale.				
Overcurrent Protection (A Input)	2 amps/600V (fused)				
Overcurrent Protection (10A Input)	Up to 20 amps for 30 seconds (unfused)				
AC Current	**3000**	**3010**	**3010UL**	**3020/3020B**	**RMS 3030**
Ranges	200μA, 2mA, 20mA, 200mA, 2A	200μA, 2mA, 20mA, 200mA, 2A, 10A			
Resolution	μA on 200μA range				
Accuracy 45Hz-2kHz (except 10A)	2.0% rdg. ±4 digits	1.5% rdg. ±3 digits		0.9% rdg. ±3 digits	
2kHz-5kHz (except 2A and 10A ranges)	Not specified				1.5% rdg. ±3 digits
45Hz-400Hz (10A range)	Not available	2.0% rdg. ±3 digits		1.5% rdg. ±3 digits	
Conversion Type	Average sensing				True RMS (ac + dc)
Response Time	Less than 2 seconds (on RMS 3030, above 10% of full scale)				
Voltage Burden	200μA to 200mA ranges: 250mV maximum at full scale 2A and 10A ranges: 700mV maximum at full scale				
Overcurrent Protection (A Input)	2 amps/600V (fused)				
Overcurrent Protection (10A Input)	Not available	Up to 20 amps for 30 seconds (unfused)			
General	**3000**	**3010**	**3010UL**	**3020/3020B**	**RMS 3030**
Operating Temperature	0°C to +50°C				
Storage Temperature	−40°C to +65°C, battery removed				
Maximum Common Mode Voltage	1500Vdc or peak ac				
Display	3½-digit LCD (1999 max. count)				
Power	Single standard 9V battery, NEDA 1604				
Battery Life	Alkaline: 2000 continous hours typical. Zinc-carbon: 1600 continuous hours typical				
Low Battery Indicator	Decimal point blinks during the last 200 hours of battery life				
Shock and Vibration	Meets MIL-T-28800 specifications				
Relative Humidity	0-80%, 0°C to 35°C; 0-70%, 35°C to 50°C				
Temperature Coefficient	Less than 15% of applicable accuracy spec. per °C (0°C to 20°C, 30°C to 50°C)				
Dimensions	6.85 in. L × 3.65 in. W × 1.8 in. H (17.4cm L × 9.3cm W × 4.6cm H)				
Case Material	High impact, fire retardant, ABS plastic				
Weight	16 oz. (453g) including battery				
Calibration	Accuracy specifications guaranteed for 1 year				
Calibration Adjustments	One adjustment for 3000, 3010, 3010UL, and 3020/3020B. Four adjustments for RMS 3030.				
Measurement Rate	4 measurements per second, nominal				

SECTION TWO

MAINTENANCE AND SERVICING

1 GENERAL

This section contains procedures for calibration, maintenance, and repair of the Series 300, Series 3000, and HD Series Multimeters. Also included are procedures for Multimeter disassembly, component replacement, Function/Range Switch disassembly and check procedures. If you are uncertain about what maintenance and service to perform, refer to Section Four TROUBLESHOOTING.

2 SERVICING POLICY

ONE YEAR LIMITED WARRANTY POLICY ON NEW INSTRUMENTS

The Beckman Digital Multimeter is warranted in its entirety against any defects of material or workmanship which develop for any reason whatsoever, except abuse, within a period of one (1) year following the date of purchase of the Multimeter by the original purchaser. This warranty is extended by Beckman Instruments, Inc. (Beckman), only to the original purchaser or original user of the Multimeter, who must, as a CONDITION PRECEDENT TO WARRANTY COVERAGE AND PERFORMANCE THEREUNDER BY BECKMAN, complete and return the Warranty Registration Card, received on purchase of the Multimeter.

In the event a defect develops during the warranty period, Beckman will, at Beckman's election, repair or replace the Multimeter with a new or reconditioned model of equivalent quality. To obtain performance of any obligation of Beckman under the warranty, the original purchaser or original user must return the defective Multimeter, postage prepaid, along with a handling charge of $3.00 (prices subject to change), to:

Beckman Instruments, Inc.
630 Puente Street
Brea, CA 92621
Attention: Customer Service

or to any other authorized Beckman Service Center.

In the event of replacement with a new or reconditioned model, the replacement unit will continue the warranty period of the original Multimeter. Replacement units will be returned by air, typically with only one (1) working day turnaround at the Service Center.

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ANY IMPLIED WARRANTIES ARISING OUT OF THE SALE OF THE MULTIMETER, INCLUDING BUT NOT LIMITED TO IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE LIMITED IN DURATION TO THE ABOVE STATED ONE (1) YEAR PERIOD. BECKMAN SHALL NOT BE LIABLE FOR LOSS OF USE OF THE MULTIMETER OR OTHER INCIDENTAL OR CONSEQUENTIAL DAMAGES, EXPENSES, OR ECONOMIC LOSS OR FOR ANY CLAIM OR CLAIMS FOR SUCH DAMAGE, EXPENSES OR ECONOMIC LOSS.

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Some states do not allow limitations on how long implied warranties last or the exclusion or limitations of incidental or consequential damages, so the above limitations or exclusions may not apply to you.

This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

2.1 After-Warranty Repair or Exchange Service

After-warranty service is provided by Beckman in two ways. You may elect to have your instrument repaired at an authorized Beckman repair facility, or you can exchange your defective out-of-warranty instrument for a reconditioned instrument at a flat rate contained on Beckman's current price list. The replacement unit carries a three (3) month limited warranty. Contact any authorized Beckman Distributor or Beckman Instruments, Inc., for the current non-warranty replacement rates and instructions for shipping the instrument.

2.2 Calibration Service

Each Beckman Multimeter should be calibrated at least once a year or after it is repaired. A procedure to accomplish this is contained in this section. If you do not have the necessary equipment specified to accomplish calibration, this service

can be performed by an authorized Beckman Service Center. If you wish to take advantage of this service, contact any authorized Beckman distributor, repair facility, or Beckman Instruments, Inc., for current calibration rates and instructions for shipping the instrument.

3 SERVICING PROCEDURES FOR HAND-HELD METERS

3.1 Multimeter Disassembly Procedure

Before performing any of the Multimeter servicing, it is necessary to disassemble the instrument, remove four screws, and carefully lift off back cover.

After performing the service or inspection, reassemble the instrument, being careful to hold shield so that it goes inside the housing without being bent or crushed. Improper reassembly can damage foil shield, resulting in improper operation of the multimeter.

3.2 Battery Replacement

> CAUTION: TO PREVENT ELECTRICAL SHOCK HAZARD, TURN OFF MULTIMETER AND DISCONNECT TEST LEADS BEFORE REMOVING BACK COVER.

After disconnecting test leads and turning off Multimeter, remove back cover by removing four screws, then lift off back cover.

> CAUTION: FAILURE TO TURN OFF INSTRUMENT BEFORE INSTALLING BATTERY COULD RESULT IN DAMAGE TO BATTERY IF IT IS CONNECTED INCORRECTLY TO TERMINALS.

3.2.1
Disconnect battery from instrument and replace with new standard 9-volt transistor battery.

3.2.2
Replace back cover and secure with four screws.

WARNING > DO NOT OPERATE MULTIMETER WITH BACK COVER REMOVED (EXCEPT DURING CALIBRATION).

3.3 Fuse Replacement

CAUTION: TO PREVENT ELECTRICAL SHOCK HAZARD, TURN OFF MULTIMETER AND DISCONNECT TEST LEADS BEFORE REMOVING BACK COVER.

After disconnecting test leads and turning off Multimeter, remove back cover.

3.3.1
The fuse is located in the upper half of the instrument on the older models and in the lower half on the latest models.

3.3.2
Remove the old fuse and replace with good fuse. If spare fuse is missing, replace it also.

CAUTION: TO PREVENT FIRE, USE ONLY TYPE AGX 2A/600V FUSE.

3.3.3
Replace back cover and secure with four screws.

3.4 Multiprocessor Chip and Liquid Crystal Display Replacement

If you have determined that either the multiprocessor chip or the display needs to be replaced, this can be accomplished by following the procedure in Figure 1 and Figure 3.

3.5 Elastomer Strips Cleaning and Replacement Procedure

If display segments do not function or if a corrective action step in the troubleshooting guide instructs you to inspect or replace an elastomer strip, access to these connectors can be gained by performing the procedure in Figure 2.

3.6 Small Circuit Board Inspection and Replacement Procedure

Inspecting the small circuit board to determine if the Function/Range Switch is working properly or replacement of the small circuit board because of faulty operation requires the following procedure.

3.6.1
After removing back cover of Multimeter, remove battery and battery case. Disconnect female input connectors with needle-nosed pliers on older models. HD Series Models and newer models will have two extra screws which need to be removed before separating module from front case. Newer models do not have female connectors, but instead input jacks directly soldered to the board.

3.6.2
Remove two No. 6 screws from rear of small circuit board.

3.6.3
Grasp outer edge of circuit boards and gently separate them from the front cover assembly. On HD models, remove the heavy-duty shock mount.

CAUTION: CIRCUIT BOARDS ARE STATIC SENSITIVE--HANDLE BY EDGES ONLY

3.6.4
With electronics assembly facing downward, squeeze together the prongs holding the retainer bar. Apply light pressure downward to free retainer from prongs. Repeat with the second set of prongs.

3.6.5
Again squeeze prongs if necessary, and carefully remove multiprocessor chip.

CAUTION: Multiprocessor chip is an extremely sensitive CMOS device. Handle chip with approved procedure (using bracelet, etc.).

Note: If you are replacing only the multiprocessor chip, proceed to Step 3.6.4. If replacing the display, go on to Steps 3.6.2, 3.6.3 and then 3.6.9.

FIGURE 1

3.6.6
Using forceps, carefully remove the two elastomer (zebra) strips from the multiprocessor chip holder.

CAUTION: DO NOT PINCH ZEBRA STRIPS OR TOUCH THEM WITH YOUR FINGERS. THEY CAN EASILY BECOME CRUSHED OR CONTAMINATED, THUS IMPAIRING CONDUCTIVITY.

FIGURE 2

3.6.7
Once again, squeeze prongs together and remove the display face and chip retainer from the circuit board.

3.6.8
Using caution, remove zebra strip from top of display retaining assembly.

3.6.9
To remove liquid crystal display, insert a small flat blade screwdriver between the retainer and the faceplate. Gently pry along the edge to unlatch all tabs, then remove retainer.

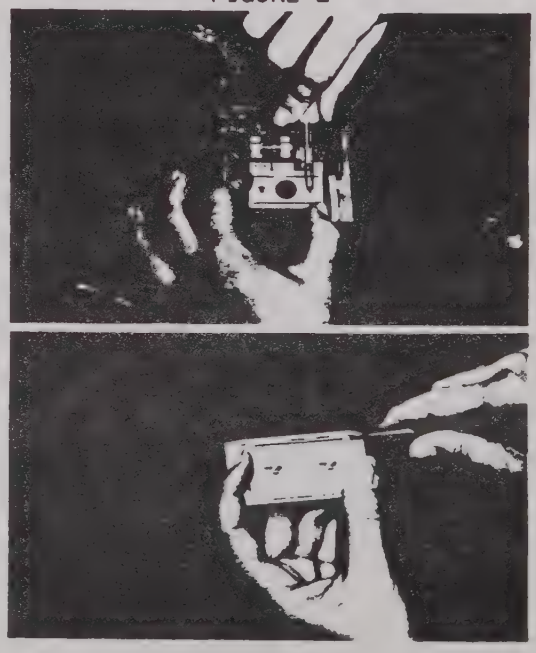


FIGURE 3

3.6.10
Remove LCD display, taking care to touch only the edges of the glass.

3.6.11
Place new display face-down into faceplate. Notice which edge of the LCD has stripes in the glass--this is the connector edge. Align the clear retainer over the rear of the display by matching the slot for the zebra strip with the connector edge of the LCD. Snap retainer into place, making sure that all tabs are fully engaged.

3.6.12
Replace zebra strip in slot at edge of retainer.

3.6.13
Position display assembly with zebra strip toward top of circuit board. Insert display assembly prongs into two holes on large circuit board. Snap together by applying gentle pressure and squeezing prongs together.

3.6.14
Place multiprocessor chip holder onto tabs. Make sure the indexing boss on right-hand underside of holder is inserted into index hole in the circuit board. Refer to Figure 2.

3.6.15
Insert two cleaned or new zebra strips into slots on chip retainer. (Reference "Elastomer Strips Cleaning Procedure" documented earlier in this section).

CAUTION: AVOID PINCHING ZEBRA STRIPS OR TOUCHING THEM WITH YOUR FINGERS.

3.6.16
Carefully place multiprocessor chip onto holder, gold connector side toward the circuit board. Align notch on side of chip with tab on side of chip holder.

3.6.17
Install chip retainer over chip and two prongs. Press downward with firm, even pressure until prongs are spread outward, holding retainer in place.

3.6.18
Insert electronics assembly into front cover. It may be necessary to turn the Function/Range knob on the front of the meter so that its shaft will align with the opening in the cam on the circuit board.

3.6.19
Insert two screws into back of circuit board assembly and tighten.

3.6.20
On older models, push female input circuit board connectors onto pins protruding from small circuit board. Be sure that these connectors fit snugly. Position leads so they will not be pinched by battery pack or between housings.

3.6.21
Reinstall battery into battery pack and connect plug. Place battery pack onto mounting slots provided. Route leads so they will not be pinched or contact input terminals.

3.6.22
Reassemble Multimeter.

3.7 Removal, Replacement, and Inspection Procedure for Electronics Assembly

3.7.1
Remove electronics assembly from Multimeter housing as described in Step 3.6.2.

3.7.2
Place electronics assembly on a flat surface with display facing upward. Remove two screws.

3.7.3
Holding circuit boards by outer edges, gently pull the two boards apart.

CAUTION: DAMAGE TO FUNCTION/RANGE SWITCH MAY RESULT IF CIRCUIT BOARDS ARE NOT PULLED STRAIGHT APART AS SHOWN.

3.7.4
Carefully remove switch cam from circuit board and remove detent spring from switch block.

3.7.5
Disassembly is now complete and Multimeter is exposed for inspection, repair, or replacement of parts. After these are completed, proceed to Step 3.7.6 for reassembly.

3.7.6
Carefully engage cam onto large circuit board assembly. T-slotted hub of cam should fit downward into hole.

CAUTION: DO NOT ENGAGE CAM AT AN ANGLE AS DAMAGE TO DELICATE SWITCH CONTACTS COULD OCCUR.

3.7.7
Insert detent spring into slot beside cam, with the protrusion facing toward the cam. The detent spring may be mounted on either side. See Figure 4.

FIGURE 4

3.7.8
Engage connector on bottom edge of circuit boards and gently press the two circuit boards together. Make sure that hub of cam fits into place on the small circuit board, and that the detent spring and two mounting brackets all fit well together.

3.7.9
When two circuit boards are back together, insert two screws in front of assembly and tighten. Reassemble entire meter, using procedure described in Step 3.6.18.

3.8 Calibration Procedures

To maintain the accuracy specification of the Multimeter, it is important that the Multimeter be calibrated at least once a year and every time it is repaired. The test equipment necessary to accomplish this procedure is described below:

INSTRUMENT	CHARACTERISTICS	RECOMMENDED MODELS
DC Calibrator	Voltage Range: 0 to 1000Vdc Accuracy: ±0.025%	Rotek 600 or Equivalent
AC Calibrator	Voltage Range: 0 to 110Vac Frequency Range: 400Hz to 20kHz Accuracy: ±0.5% at 400Hz ±0.5% at 20kHz	Rotek 600, 745A or Equivalent

3.8.1 DC Calibration

1. Perform calibration at ambient temperature of 25 ±2°C and relative humidity of 80% or less.

   Note: ALLOW INSTRUMENT TO STABILIZE AT THIS TEMPERATURE FOR AT LEAST THIRTY MINUTES BEFORE PROCEEDING WITH CALIBRATION.

2. Remove back cover from instrument, using procedure described in Step 3.1.

3. Adjust output of DC calibrator for 190mV ±0.02% and connect to volt/ohm and COM input connectors on Multimeters.

4. Turn Function/Range Switch on Multimeter to 200mV DCV position.

5. Using small flat-tipped screwdriver, adjust potentiometer R5 (as shown in Figure 5) until Multimeter display reads +190.0 or +190.1.

6. Disconnect DC calibrator from Multimeter.

7. Replace back cover and secure.

3.8.2 Calibration of True-RMS Models

1. Perform DC calibration as just described.

2. Short Multimeter voltage input terminals.

3. Turn Function/Range Switch to 1000V ACV position.

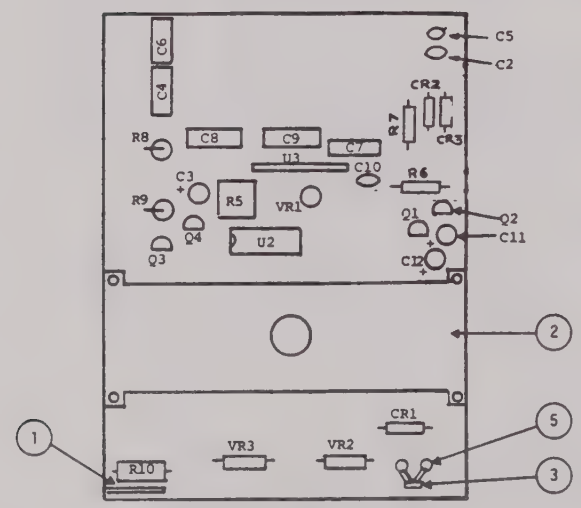


FIGURE 5. LARGE CIRCUIT BOARD NON-RMS MODELS

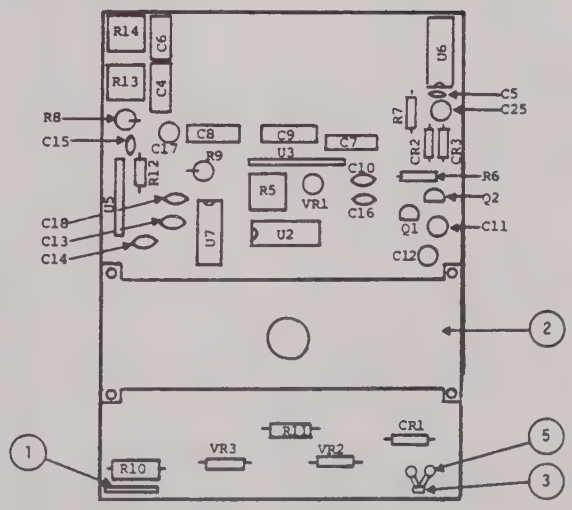


FIGURE 6. LARGE CIRCUIT BOARD RMS MODELS

4. Adjust potentiometer R13--the AC zero adjustment (shown in Figure 6)--until the digital display reads 000 or 001. Make this adjustment very slowly to allow instrument to stabilize.

5. Turn Function/Range Switch to 200mV ACV position.

6. Set output of DC calibrator to 190mV. Connect DC calibrator to V/Ohm and COM inputs on Multimeter (polarity is not important).

7. Adjust potentiometer R14--the AC fullscale adjustment (shown in Figure 6)--until digital display reads 190.0 ±1 digit.

8. Disconnect DC calibrator from Multimeter.

9. Place Function/Range Switch on Multimeter in 2V ACV position and set AC calibrator for output of 1.900V, 20kHz.

10. Temporarily reinstall back cover of Multimeter.

11. Connect AC calibrator to V/Ohm and COM inputs and note reading. Ensure that COM or "low" side terminal of AC calibrator is matched with Multimeter COM input.

12. Remove Multimeter back cover and again note display reading. The difference between the first and second readings is the error voltage.

    Note: At 20kHz, (calibration frequency) 2Vac Multimeter readings tend to be higher with back cover shield removed than with cover attached. Adjust Multimeter to read higher than calibration standard voltage so that, with cover attached, desired output is achieved.

13. Adjust trimming capacitor C19--high-frequency adjust (as shown in Figure 7)--until the display reads a value equal to 1.900 plus the error voltage.

14. Reinstall Multimeter back cover and secure.

15. Verify that the display reads 1.900 ±20 digits.

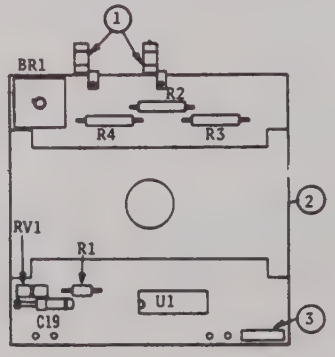


FIGURE 7. SMALL CIRCUIT BOARD RMS MODELS

A. REPAIR DECISION TREE

I METER IN 2 VDC RANGE (NO INPUT)

A. DISPLAY BLANK

1) CHECK BATTERY VOLTAGE (>8.00V).
2) CHECK BATTERY LEADS FOR CONTINUITY.
3) CHECK SWITCH--See Note 1.
4) CHECK CURRENT OF MODULE:
   A) DISCONNECT ONE BATTERY TERMINAL.
   B) PLACE ONE LEAD OF METER INTO DISCONNECTED TERMINAL OF BATTERY AND OTHER LEAD INTO DISCONNECTED BATTERY SNAP TERMINAL.
   CURRENT OF MODULE SHOULD READ FROM "0.230 MA" TO "0.480 MA."

IF CURRENT READING IS

- **1 OL**
  1) CHANGE THE MULTIPROCESSOR CHIP (U4). EVEN IF THIS DOES NOT SOLVE PROBLEM, CHECK RESISTOR NETWORK ATTENUATOR (U1)--See Note 2.
  2) INSPECT SMALL SIGNAL DIODE (CR1) NEAR BATTERY LEADS. DIODE TEST SHOULD READ APPROX "0.6" TO "0.75."
     IF IT READS "OL" BOTH DIRECTIONS, REPLACE DIODE (CR1).
- **2 .000 (MODULE NOT IN OFF POSITION)**
  1) CHECK SWITCH (13B) FOR OPEN.
  2) INSPECT HEADGEAR PLASTICS ASSEMBLY FOR PROPER ASSEMBLY.
  3) CLEAN PC BOARD UNDER SILVER ELASTOMERIC CONNECTORS BETWEEN LARGE PC BOARD AND MULTIPROCESSOR CHIP (U4).
  4) REPLACE SILVER ELASTOMERIC CONNECTORS.
  5) CHECK LARGE PC BOARD POWER TRACE FROM "+" SIDE OF BATTERY PAD TO CHIP PAD #31--See Note 4.
- **3 CORRECT**
  1) CHECK THAT LCD IS INSTALLED CORRECTLY.
  2) CLEAN PC BOARD UNDER CARBON ELASTOMERIC CONNECTOR BETWEEN LARGE PC BOARD AND LCD DISPLAY.

A) IF DIODE (CR1) READS LOW (.000 - .600). CHECK CAPACITOR (C1) TO DETERMINE IF IT IS SHORTED. READING SHOULD BE "OL."
B) IF CAPACITOR (C1) IS OKAY, CHECK CAPACITOR (C11) THE SAME WAY.
C) IF CAPACITORS (C1,C11) ARE OKAY, REPLACE SMALL SIGNAL DIODE (CR1).
D) IF CAPACITOR (C1) IS OKAY BUT SOLDER PADS GIVE A SHORTED READING, REMOVE MULTIPROCESSOR CHIP (U4) AND RESET.
E) VISUALLY INSPECT BOARD FOR PC SHORTS.

B. DISPLAY READS "0.00"

1) CHECK SWITCH--See Note 1.
2) CHECK 8-PIN CONNECTORS BETWEEN BOARDS FOR CONTINUITY.
3) IF READING IS "OL" ON ALL RANGES, REPLACE MULTIPROCESSOR CHIP (U4).
4) CHECK RESISTOR NETWORK ATTENUATOR (U1)--See Note 2.
5) CHECK REF DIODE (VR1). SHOULD READ "-1.2 VDC ±0.05V."
6) CHECK THIN FILM RESISTOR DIVIDER (U2). SHOULD READ: PINS 6-7, 30KΩ
   PINS 6-8, 132KΩ
7) CHECK CAPACITOR (C6)--See Note 3.

C. DOES NOT ZERO

1) CHECK REF DIODE (VR1). SHOULD READ "-1.2 VDC ±0.05V."
2) CLEAN PC BOARD AREA UNDER SILVER ELASTOMERIC CONNECTORS BETWEEN LARGE PC BOARD AND MULTIPROCESSOR CHIP (U4).
3) REPLACE SILVER ELASTOMERIC CONNECTORS--See Note 6.
4) CHECK IF PC BOARDS ARE DIRTY. TURN METER TO "2 VDC," BREATHE ON MODULE NEAR FUSE, AND IF ALL KINDS OF NUMBERS APPEAR, CLEAN BOARD.
5) SHORT CAPACITOR (C4) TO COMMON. IF METER "ZEROES," REPLACE CAPACITOR.

II METER IN VDC:

1) CALIBRATE WITH 190.0 MV INPUT
2) CHECK WITH 190.0 V INPUT

A. READS "000"

1) CHECK SILVER ELASTOMERIC CONNECTORS--See Note 6.
2) CHECK SWITCHES--See Note 1.
3) CHECK SPARK GAP (SG1) TO SEE IF IT IS SHORTED.
4) CHECK 10-PIN SIP RESISTOR NETWORK (U3).
5) REPLACE MULTIPROCESSOR CHIP (U4).

B. READING UNSTABLE

1) CHECK SWITCHES--See Note 1.
2) CHECK RESISTOR NETWORK ATTENUATOR (U1)--See Note 2.
3) CHECK 2KΩ ±5% RESISTOR (R1) FOR OPEN OR SHORT.
4) CHECK CAPACITORS (C7,C10)--See Note 5. IF REVERSING INPUT LEADS STABILIZES DISPLAY, REPLACE CAPACITOR (C9).
   CHECK FEED-THROUGH FROM CAPACITOR (C10) TO MULTIPROCESSOR CHIP (U4) TO CAPACITORS (C6,C7) FOR CONTINUITY.
5) REPLACE SILVER ELASTOMERIC CONNECTORS--See Note 6.
6) REPLACE MULTIPROCESSOR CHIP (U4).

C. READING INCORRECT

1) CHECK REF DIODE (VR1). SHOULD READ "1.2 VDC ±0.05V."
2) CHECK 10K POT (R5) FOR OPEN OR SHORT.
3) CHECK RESISTOR NETWORK ATTENUATOR (U1)--See Note 2.
4) CHECK 2MΩ ±5% RESISTOR (R8).
5) REPLACE MULTIPROCESSOR CHIP (U4).
6) CHECK FOR OPEN TRACE ON SMALL PC BOARD BETWEEN Vo INPUT TERMINAL PIN AND SOLDER PAD--#1 OF FEMALE 5-PIN CONNECTOR. SHOULD READ APPROX "2KΩ."
7) CHECK SWITCHES--See Note 1.
8) CHECK CAPACITOR (C11)--See Note 3.

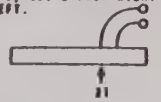
*NOTE 1 - CHECK SWITCHES: USING THE DIAGRAM, IT SHOWS WHICH SWITCH IS SUPPOSED TO BE OPEN OR CLOSED ON EVERY RANGE. THE SWITCHES ON SMALL BOARD ARE 1A TO 16A; ON BIG BOARD, 1B TO 16B. NUMBERING STARTS FROM CENTER; ODD ON ONE SIDE, EVEN ON OTHER.

*NOTE 2 - CHECK ATTENUATOR RANGES: THE MODULE ON 1500 VDC RANGE WITH BATTERY DISCONNECTED SHOULD READ:

BETWEEN		
PINS	1-14	10.0MΩ
PINS	1-4	1.01MΩ
PINS	4-5	100KΩ
PINS	5-6	10.0KΩ
PINS	6-7	1.01KΩ
PINS	7-8	100Ω
PINS	9-10	99Ω
PINS	10-11	900Ω

NOTE 3 - CAPACITORS: ON 10MΩ RANGE, OHM SIGN SHOULD APPEAR AND "OL" SHOULD APPEAR (CAPACITOR >.01 μF).

NOTE 4 - CHIP PAD #31: THE TENTH PAD, GOING FROM RIGHT TO LEFT.



NOTE 5 - CAUTION ON HANDLING CHIP.

NOTE 6 - SILVER ELASTOMERIC CONNECTORS: CLEAN WITH RUBBER ERASER. MAKE SURE RESIDUE OF RUBBER IS REMOVED WITH KIMWIPE (OR EQUIVALENT).

*CONNECTORS

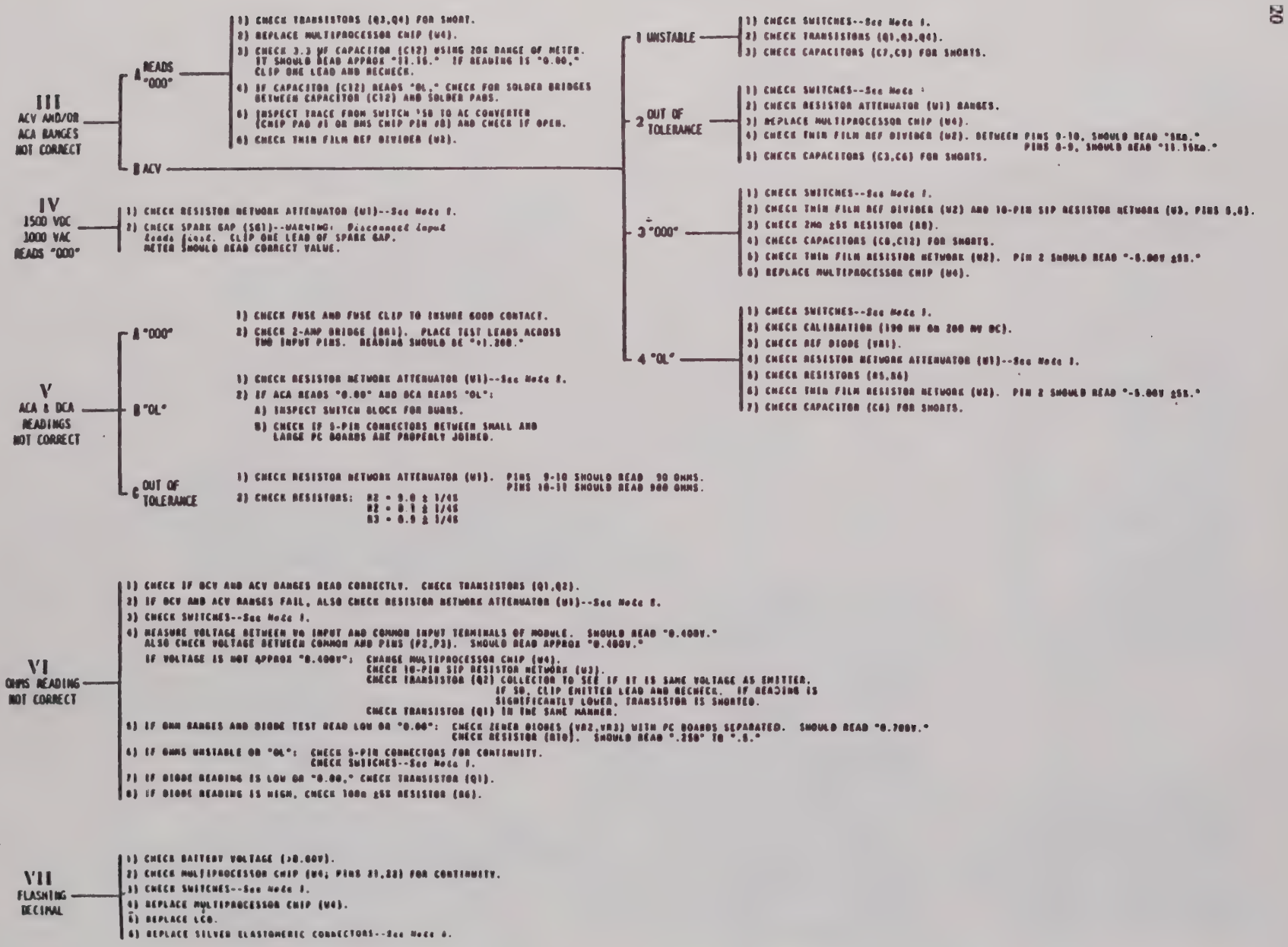
BETWEEN BOARDS, AND NUMBERING FROM THE EDGE, ARE PINS 1 TO 5 (DESIGNATED "1" ON THE SCHEMATIC):

P4 (FOURTH FROM EDGE) IS COMMON.

P2 AND P3 SHOULD READ ".000V" AND USED ONLY ON OHM RANGES AND DIODE TEST.

P1 IS VOLTS.

P5 IS CURRENT.

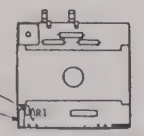

III
ACV AND/OR ACA RANGES NOT CORRECT
A READS "000"
1) CHECK TRANSISTORS (Q3,Q4) FOR SHORT.
2) REPLACE MULTIPROCESSOR CHIP (U4).
3) CHECK 3.3 MF CAPACITOR (C12) USING 20K RANGE OF METER. IT SHOULD READ APPROX "11.1K." IF READING IS "0.00," CLIP ONE LEAD AND RECHECK.
4) IF CAPACITOR (C12) READS "OL," CHECK FOR SOLDER BRIDGES BETWEEN CAPACITOR (C12) AND SOLDER PADS.
5) INSPECT TRACE FROM SWITCH "SB" TO AC CONVERTER (CHIP PAD #1 OR OHMS CHIP PIN #8) AND CHECK IF OPEN.
6) CHECK THIN FILM REF DIVIDER (U2).
B ACV
1 UNSTABLE
1) CHECK SWITCHES--See Note 1.
2) CHECK TRANSISTORS (Q1,Q3,Q4).
3) CHECK CAPACITORS (C7,C9) FOR SHORTS.
2 OUT OF TOLERANCE
1) CHECK SWITCHES--See Note 1.
2) CHECK RESISTOR ATTENUATOR (U1) RANGES.
3) REPLACE MULTIPROCESSOR CHIP (U4).
4) CHECK THIN FILM REF DIVIDER (U2). BETWEEN PINS 9-10, SHOULD READ "9kΩ." PINS 8-9, SHOULD READ "11.19kΩ."
5) CHECK CAPACITORS (C3,C6) FOR SHORTS.
3 "000"
1) CHECK SWITCHES--See Note 1.
2) CHECK THIN FILM REF DIVIDER (U2) AND 10-PIN SIP RESISTOR NETWORK (U3, PINS 5,6).
3) CHECK 2MΩ ±5% RESISTOR (R8).
4) CHECK CAPACITORS (C8,C12) FOR SHORTS.
5) CHECK THIN FILM RESISTOR NETWORK (U2). PIN 2 SHOULD READ "-5.00V ±5%."
6) REPLACE MULTIPROCESSOR CHIP (U4).
4 "OL"
1) CHECK SWITCHES--See Note 1.
2) CHECK CALIBRATION (190 MV OR 200 MV DC).
3) CHECK REF DIODE (VR1).
4) CHECK RESISTOR NETWORK ATTENUATOR (U1)--See Note 1.
5) CHECK RESISTORS (R5,R6)
6) CHECK THIN FILM RESISTOR NETWORK (U2). PIN 2 SHOULD READ "-5.00V ±5%."
7) CHECK CAPACITOR (C6) FOR SHORTS.
IV
1500 VDC 1000 VAC READS "000"
1) CHECK RESISTOR NETWORK ATTENUATOR (U1)--See Note 1.
2) CHECK SPARK GAP (SG1)--WARNING: Disconnect input leads first. CLIP ONE LEAD OF SPARK GAP. METER SHOULD READ CORRECT VALUE.
V
ACA & DCA READINGS NOT CORRECT
A "000"
1) CHECK FUSE AND FUSE CLIP TO ENSURE GOOD CONTACT.
2) CHECK 2-AMP BRIDGE (BR1). PLACE TEST LEADS ACROSS TWO INPUT PINS. READING SHOULD BE "+1.200."
B "OL"
1) CHECK RESISTOR NETWORK ATTENUATOR (U1)--See Note 1.
2) IF ACA READS "0.00" AND DCA READS "OL":
A) INSPECT SWITCH BLOCK FOR BURNS.
B) CHECK IF 5-PIN CONNECTORS BETWEEN SMALL AND LARGE PC BOARDS ARE PROPERLY JOINED.
C OUT OF TOLERANCE
1) CHECK RESISTOR NETWORK ATTENUATOR (U1). PINS 9-10 SHOULD READ 90 OHMS. PINS 10-11 SHOULD READ 900 OHMS.
2) CHECK RESISTORS: R2 = 9.0 ± 1/4% R2 = 0.1 ± 1/4% R3 = 0.9 ± 1/4%
VI
OHMS READING NOT CORRECT
1) CHECK IF DCV AND ACV RANGES READ CORRECTLY. CHECK TRANSISTORS (Q1,Q2).
2) IF DCV AND ACV RANGES FAIL, ALSO CHECK RESISTOR NETWORK ATTENUATOR (U1)--See Note 1.
3) CHECK SWITCHES--See Note 1.
4) MEASURE VOLTAGE BETWEEN Vo INPUT AND COMMON INPUT TERMINALS OF MODULE. SHOULD READ "0.400V." ALSO CHECK VOLTAGE BETWEEN COMMON AND PINS (P2,P3). SHOULD READ APPROX "0.400V."
IF VOLTAGE IS NOT APPROX "0.400V": CHANGE MULTIPROCESSOR CHIP (U4). CHECK 10-PIN SIP RESISTOR NETWORK (U3). CHECK TRANSISTOR (Q2) COLLECTOR TO SEE IF IT IS SAME VOLTAGE AS EMITTER. IF SO, CLIP EMITTER LEAD AND RECHECK. IF READING IS SIGNIFICANTLY LOWER, TRANSISTOR IS SHORTED. CHECK TRANSISTOR (Q1) IN THE SAME MANNER.
5) IF OHM RANGES AND DIODE TEST READ LOW OR "0.00": CHECK ZENER DIODES (VR2,VR3) WITH PC BOARDS SEPARATED. SHOULD READ "0.700V." CHECK RESISTOR (R10). SHOULD READ ".250" TO ".5."
6) IF OHMS UNSTABLE OR "OL": CHECK 5-PIN CONNECTORS FOR CONTINUITY. CHECK SWITCHES--See Note 1.
7) IF DIODE READING IS LOW OR "0.00," CHECK TRANSISTOR (Q1).
8) IF DIODE READING IS HIGH, CHECK 100Ω ±5% RESISTOR (R6).
VII
FLASHING DECIMAL
1) CHECK BATTERY VOLTAGE (>8.00V).
2) CHECK MULTIPROCESSOR CHIP (U4; PINS 21,22) FOR CONTINUITY.
3) CHECK SWITCHES--See Note 1.
4) REPLACE MULTIPROCESSOR CHIP (U4).
5) REPLACE LCD.
6) REPLACE SILVER ELASTOMERIC CONNECTORS--See Note 6.

B. P.C. BOARD CROSS REFERENCE

● FIRST GENERATION ●● SECOND GENERATION ●●● THIRD GENERATION ●●●● FOURTH GENERATION

INPUT BOARD

S



3000-502-008

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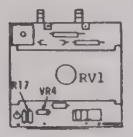

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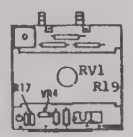

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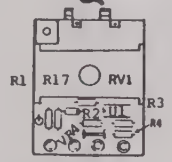

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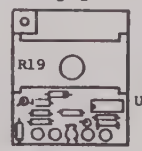
A



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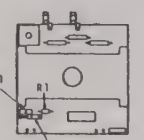

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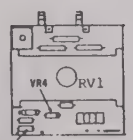

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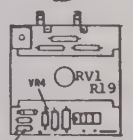

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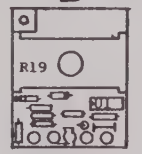
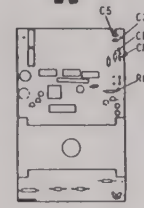
B



3000-510-114

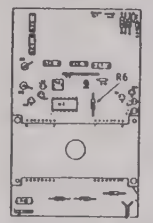
DISPLAY BOARD

W



3000-501008

R



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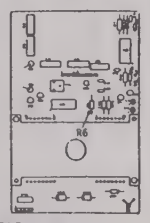

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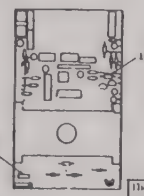
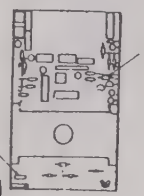


These part numbers refer to actual number on the boards

3000-510-100

Z



3000-510-100

MODEL	PART NUMBER ON DISPLAY PC BOARD	REPLACEMENT BOARD ORDERING NUMBER	PART NUMBER ON INPUT PC BOARD	REPLACEMENT BOARD ORDERING NUMBER
*MD-100	(R) 3000-510-108	FG3000-980-113	(N) 3000-510-107 **(Q) 3000-526-23 (C) 3000-510-122 **(A) 3000-510-115	FG3000-980-112 FG3000-980-117 FG3000-980-112 FG3000-980-117
*MD-110	(R) 3000-510-108	FG3000-980-113	**(Q) 3000-526-23 **(A) 3000-510-105	FG3000-980-117 FG3000-980-117
TECH 300	(W) 3000-501-008 (R) 3000-510-108	FG3000-980-113 FG3000-980-113	(S) 3000-502-008 (N) 3000-510-107 **(A) 3000-510-115 **(Q) 3000-526-23 (C) 3000-510-122	FG3000-980-112 FG3000-980-112 FG3000-980-117 FG3000-980-117 FG3000-980-112
3000, TECH 310, 3010, TECH 310UL, 3010UL, 3020	(W) 3000-501-008 (R) 3000-510-108	FG3000-980-113 FG3000-980-113	(S) 3000-502-008 (N) 3000-510-107 (C) 3000-510-122 *(Q) 3000-526-23 *(A) 3000-510-115	FG3000-980-112 FG3000-980-112 FG3000-980-112 FG3000-980-117 FG3000-980-117
3020B TECH 320B	(P) 3000-510-108	FG3000-980-116	(N) 3000-510-107 *(Q) 3000-526-23 *(A) 3000-510-115 (C) 3000-510-122	FG3000-980-112 FG3000-980-117 FG3000-980-117 FG3000-980-112
3030 TECH 330	(X) 3000-510-100 (Z) 3000-510-100	FG3000-980-111 FG3000-980-111	(T) 3000-500-008 (K) 3000-510-109 *(B) 3000-510-114 (D) 3000-510-124	FG3000-980-114 FG3000-980-114 FG3000-980-115 FG3000-980-114

*All MD-type meters require straight-end test leads
**If Q,A, or B boards are used, a new front case and straight-end test leads are required

*EXAMPLE OF HOW TO USE THIS TABLE: Let's say that one has a Model 3000 or Tech 310, and the input board (part number printed on the board--3000-502-008) needs to be replaced. To get the replacement board, one should order (according to this table) FG3000-980-112.

GENERAL NOTES:

I. DIFFERENCES BETWEEN FIRST GENERATION AND SECOND GENERATION:

Second generation input boards have the following changes:

1) RV1, MOV (FG3000-80-102), instead of spark gap
2) R1, 2KΩ, 1/2W resistor (FG3000-031-202), instead of 2KΩ, 1/4W resistor
3) VR4, zener diode (FG3000-231-101)
4) R17, 240Ω, 1/2W resistor (FG3000-031-241)

Second generation display boards have the following changes:

1) R10, 750Ω PTC (FG3000-082-103), instead of 500Ω PTC
2) R6, 240Ω, 1/4W resistor (FG3000-1-241) instead of 100Ω resistor

These changes will provide a 2mA output on diode test instead of 5mA, and a 500 Vdc overload protection on resistance ranges instead of 300 Vdc.

II. DIFFERENCES BETWEEN SECOND AND THIRD GENERATION

Third generation input boards have the following changes:

1) Input jacks are on board instead of on front case
2) R4, .0898Ω resistor (FG3000-071-104), instead of .1Ω
3) 10A shunt (FG3000-040-101) is on the board instead of on the front case.

Third generation front cases are designed to accept the new input jacks.

III. WHEN SECOND GENERATION INPUT BOARDS ARE USED WITH FIRST GENERATION DISPLAY BOARDS, THE FOLLOWING CHANGES MUST BE MADE:

1) Replace 100Ω resistor (R6) with 240Ω (FG3000-1-241)
2) Replace 500Ω PTC (R10) with 750Ω PTC (FG3000-82-103)

These changes provide a 2mA output on diode test instead of 5mA and provide a 500 Vdc overload protection on resistance ranges instead of 300 Vdc.

IV. TO ACCOMMODATE THE FLEX CABLE CONNECTOR OF THE INPUT BOARDS, THE FEMALE 5-PIN CONNECTOR (FG3000-370-144) NEEDS TO REPLACE THE SOLID 5-PIN CONNECTOR ON THE DISPLAY BOARD.

V. ALL INPUT BOARDS WILL HAVE HIGHEST GRADE (.1%) ATTENUATORS (FG3000-313-101)

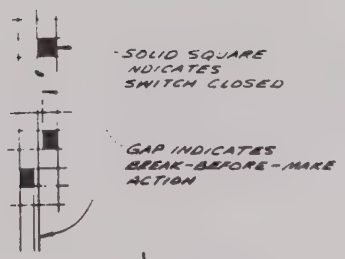
VI. DO NOT USE FIRST GENERATION INPUT BOARDS WITH SECOND GENERATION DISPLAY BOARDS.

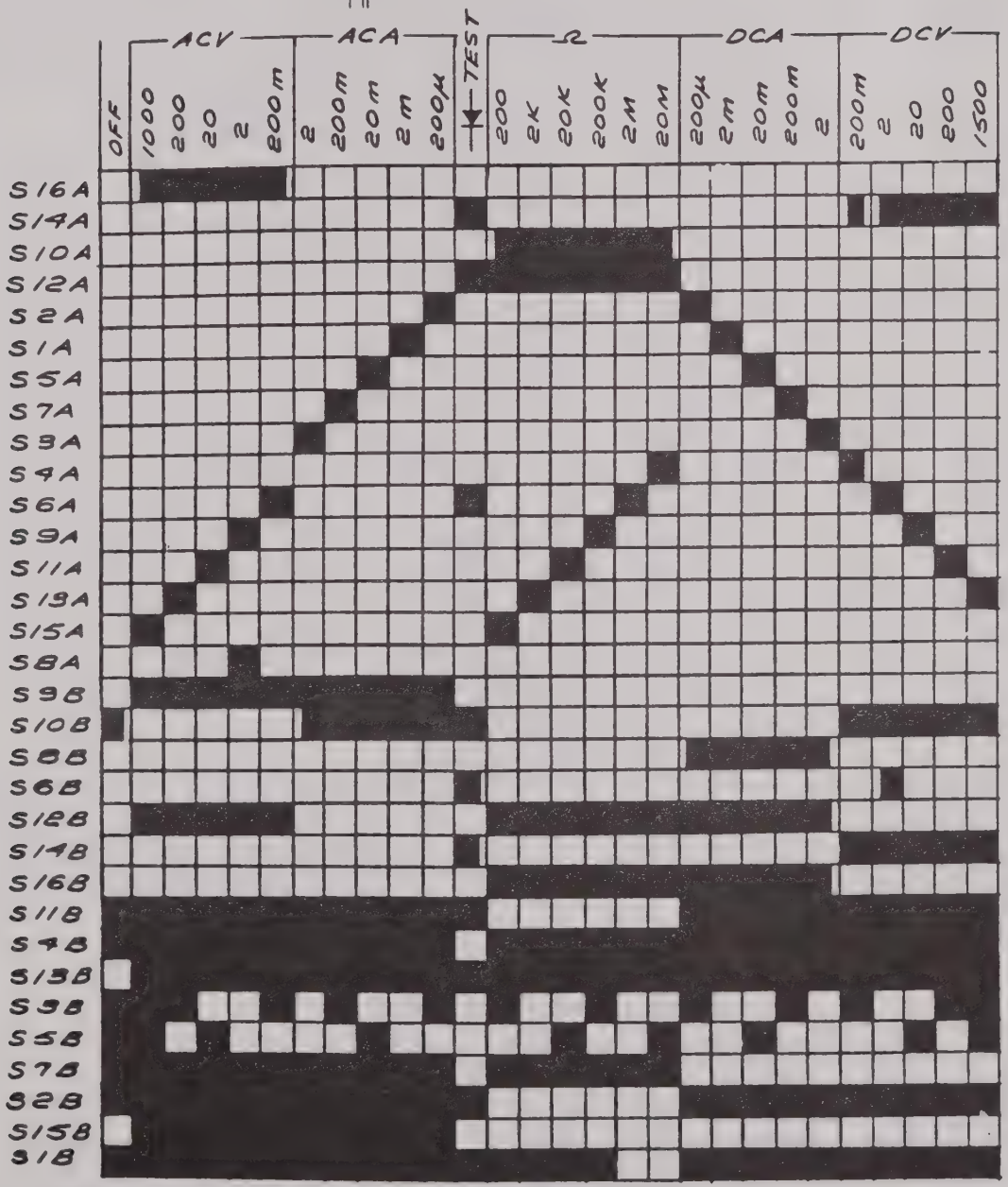
VII. DIFFERENCES BETWEEN THIRD AND FOUR GENERATION

1) The fuse clips are moved from the top of the board to the bottom of the board
2) A 19.8MΩ (R19) discrete resistor is added to replace the one from the attenuator (U1), making it a 2.2MΩ attenuator (U1).

VIII. THE REPLACEMENT BOARDS FOR THE FIRST TWO GENERATIONS--(S,N) AND (T,M)--ARE SHOWN IN FIGURES C AND D. THEY ALSO HAVE A TWO-PIECE ATTENUATOR.

S = Switch Contact
A = Input (Small) Board
B = Display (Large) Board



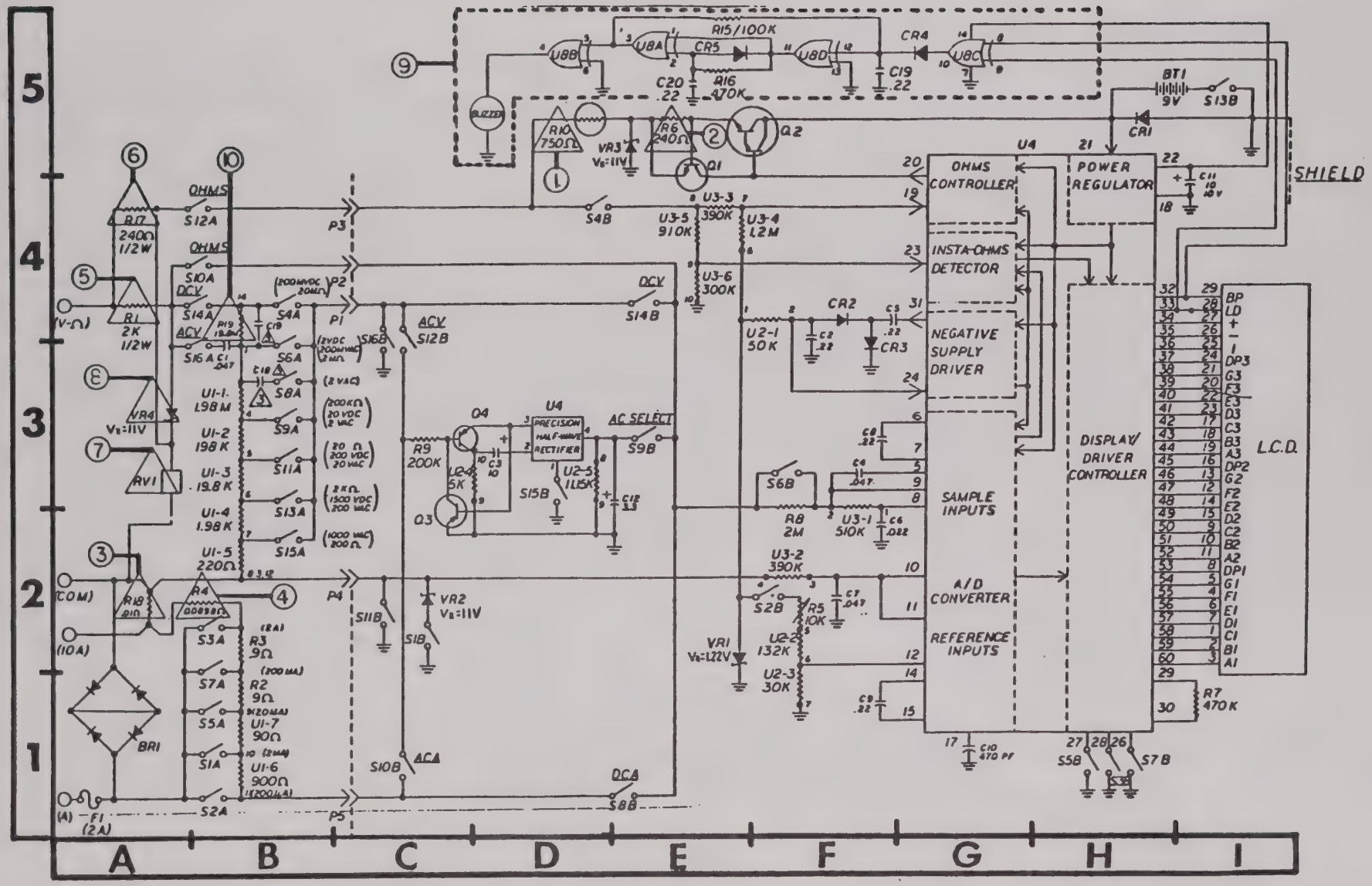


C. FUNCTION/RANGE SWITCH CONTACT POSITION MATRIX HAND-HELD METERS

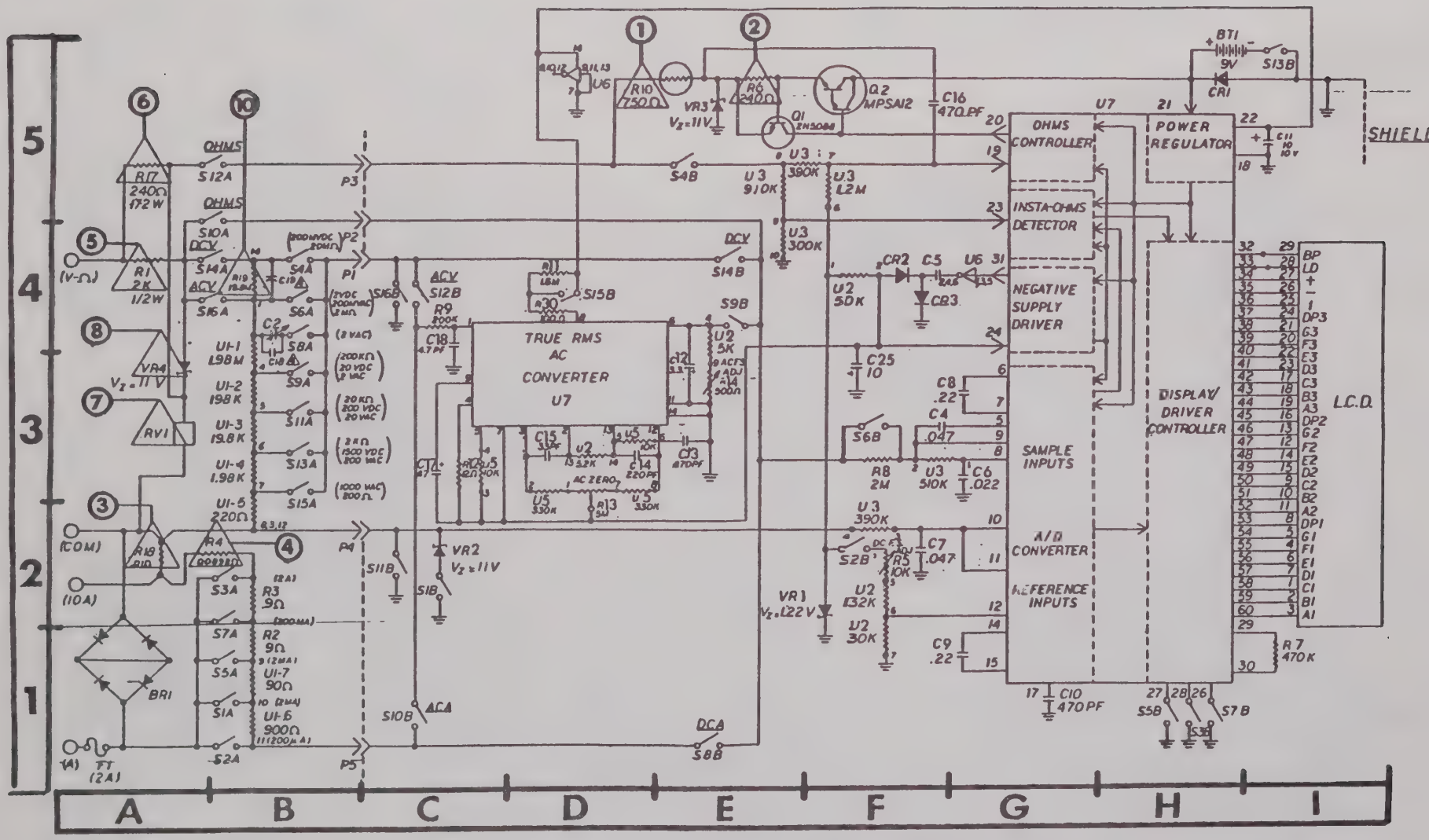
CLOCKWISE →

NOTES

NBR	PART ON SCHEMATIC	BOARD NBR	DESCRIPTION	COMMENTS
1	R10	3000-501-008 3000-510-100 3000-510-108	500Ω PTC 500Ω PTC 750Ω PTC	
2	R6	3000-501-008 3000-510-100 3000-510-108	100Ω Resistor 100Ω Resistor 240Ω Resistor	3000-510-108: 2mA on diode test
3	R18	3000-526-023 3000-510-114 3000-510-115	.01Ω Shunt .01Ω Shunt .01Ω Shunt	10A switch on board instead of mechanism
4	R4	3000-510-115 3000-526-023 3000-510-114 3000-502-008 3000-510-107 3000-510-109 3000-500-008	.0898Ω Res. .0898Ω Res. .0898Ω Res. .1Ω Res. .1Ω Res. .1Ω Res. .1Ω Res.	Part of 10A switch on board
5	R1	3000-500-008 3000-502-008 3000-526-023 3000-510-107 3000-510-114 3000-510-109 3000-510-115 3000-510-122 3000-510-124	2KΩ 1/4W Res. 2KΩ 1/4W Res. 2KΩ 1/2W Res. 2KΩ 1/2W Res. 2KΩ 1/2W Res. 2KΩ 1/2W Res. 2KΩ 1/2W Res. 2KΩ 1/2W Res. 2KΩ 1/2W Res.	Better protection
6	R17	3000-526-023 3000-510-114 3000-510-107 3000-510-109 3000-510-115 3000-510-122 3000-510-124	240Ω 1/2W Res. 240Ω 1/2W Res. 240Ω 1/2W Res. 240Ω 1/2W Res. 240Ω1/2W Res. 240Ω1/2W Res. 240Ω1/2W Res.	Better protection
7	RV1	3000-500-008 3000-502-008	Spark Gap (Gray)	If meter was never serviced, it probably still has spark gap, and this should be replaced with MOV (S3000).
8	VR4	3000-526-023 3000-510-114 3000-510-107 3000-510-109 3000-510-115 3000-510-122 3000-510-124	Zener Diode Zener Diode Zener Diode Zener Diode Zener Diode Zener Diode Zener Diode	Better protection
9	Beeper Circuitry	3000-510-108		Only on beeper models, 3020B or Tech 320B
10	R19	3000-502-008 3000-500-008 3000-510-107 3000-510-109 3000-526-023	19.8MΩ Res.	On these boards the 19.8MΩ resistor was part of the attenuator U1.



D. SCHEMATIC—3½ DIGIT NON-RMS MULTIMETERS



E. SCHEMATIC—3½ DIGIT RMS MULTIMETERS

SECTION THREE

REPLACEMENT PARTS AND SUPPLIES

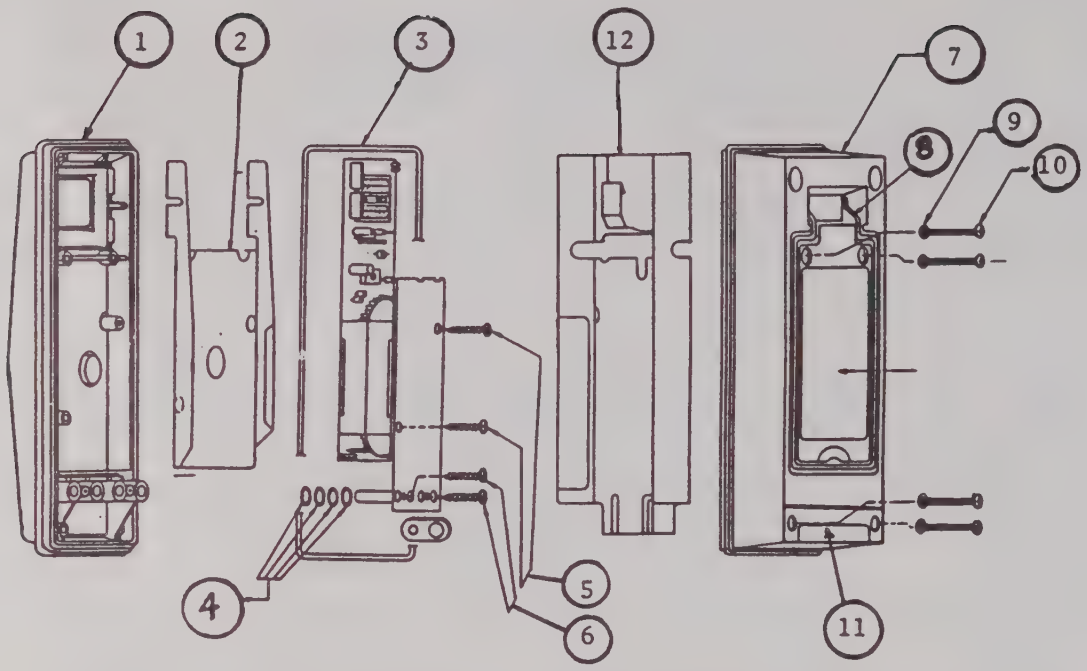
The replacement parts and supplies listed in this section may be ordered from Beckman, or your local service center. Beckman requires CASH-IN-ADVANCE to be sent along with your order to the address listed below. A sample order form is enclosed at the back of this manual. Please make sure you use it to order parts.

To determine Beckman part number and description of the part to be replaced, first find the part located on an illustration. Next, note the illustration figure number or parts index number. Locate the identical figure number on the parts list. Notice the schematic description.

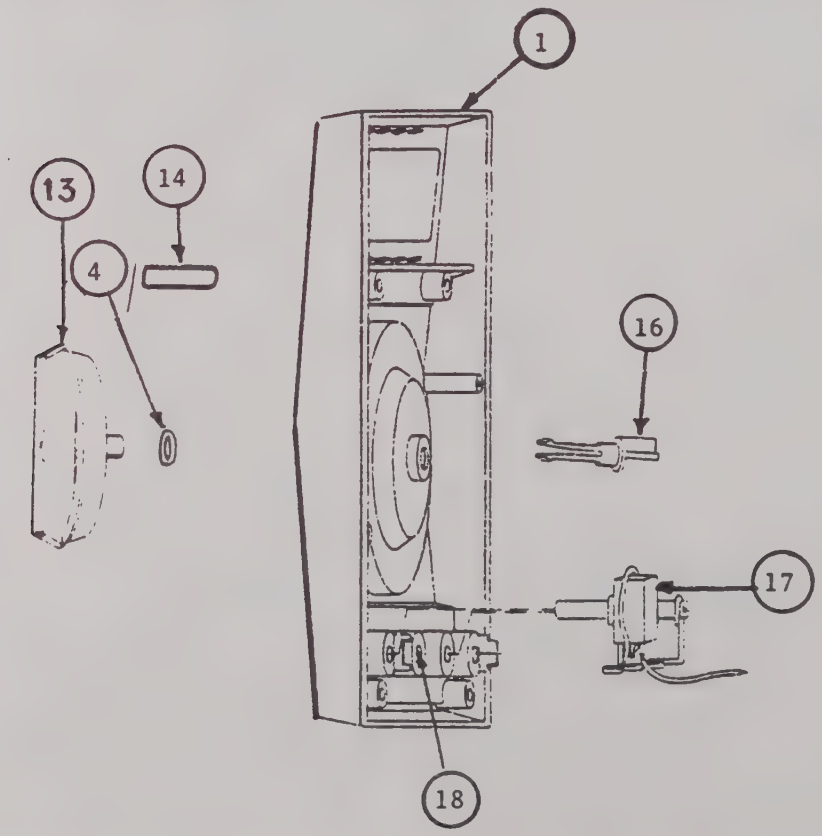
Please note Beckman address:

Beckman Instruments, Inc.
630 Puente Street
Brea, CA 92621
Attention: Customer Service

MULTIMETER ASSEMBLY



FRONT HOUSING ASSEMBLY TO MATCH STRAIGHT-END TEST LEADS



FRONT HOUSING ASSEMBLY TO MATCH RIGHT-ANGLE TEST LEADS

MULTIMETER ASSEMBLY

PARTS INCLUDED IN FRONT CASE ASSEMBLIES ARE: CASE PLASTIC, SHAFT, WINDOW, WINDOW SEAL, AND INPUT JACK OVERLAY. THE NAME LOGO IS THE ONLY PART NOT INCLUDED ON CASES WHICH CAN BE INTERCHANGED. LOGOS CAN BE PURCHASED SEPARATELY.

PARTS INCLUDED IN REAR CASE ASSEMBLY ARE: REAR PLASTIC CASE, BATTERY COVER, BAIL, RUBBER FEET, RUBBER STRIPS. REAR CASES LISTED MATCH WITH EITHER OF THE FRONT CASES SHOWN.

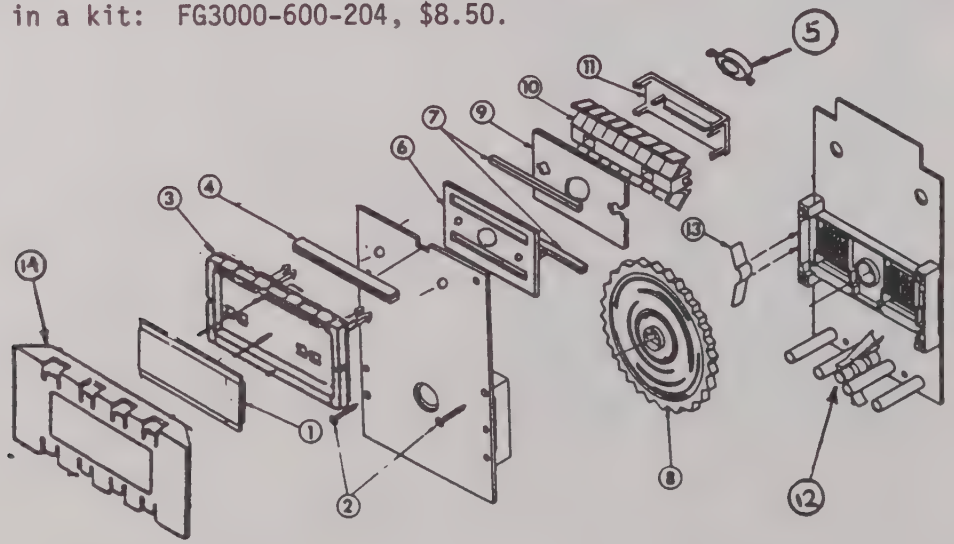
INDEX NBR	BECKMAN PART NBR	DESCRIPTION	SUGGESTED RETAIL*
	FRONT BASE ASSEMBLIES AND PARTICULAR PARTS TO MATCH RIGHT ANGLE TEST LEADS:		
1	FG3000-410-111	TECH 300	13.30
	FG3000-410-110	3000	13.30
	FG3000-410-110	3010,3020,3030,3020B	13.30
	FG3000-421-144	3010UL	13.30
	FG3000-410-112	TECH 310,TECH 330, TECH 320B	13.30
	FG3000-420-172	HD-100	23.00
17	FG3000-526-21	10-AMPERE SHUNT ASSEMBLY	8.00
17	FG3000-526-22	10-AMPERE SHUNT ASSEMBLY - UL ONLY	10.00
2	FG3000-450-116	SHIELD - UPPER	1.50
	FG3000-410-116	BATTERY COVER ASSEMBLY	3.36
18	FG3000-543-21	JACK ASSEMBLY KIT	1.40
18	FG3000-543-23	JACK ASSEMBLY KIT - UL METERS	2.00
	FRONT CASE ASSEMBLIES TO MATCH STRAIGHT END TEST LEADS		
1	FG3000-572-100	TECH 300	13.30
	FG3000-571-106	3000	13.30
	FG3000-980-132	TECH 310,TECH 330, TECH 320B	13.30
	FG3000-572-119	TECH 310UL	13.30
	FG3000-980-133	3010,3020,3020B,3030	13.30
	FG3000-572-118	3010UL	13.30
	FG3000-980-118	HD-100, HD-110	23.00
	PARTS WHICH ARE USED IN BOTH STYLES OF METERS		
14	FG3000-920-301	TECH 310 LOGO	1.50
	FG3000-920-303	TECH 320B LOGO	1.50
	FG3000-920-302	TECH 330 LOGO	1.50
	FG3000-920-310	3010 LOGO	1.50
	FG3000-920-320	3020 LOGO	1.50
	FG3000-920-330	3030 LOGO	1.50
	FG3000-920-322	3020B LOGO	1.50
	FG3000-920-299	HD-100 LOGO	1.50
	FG3000-920-112	HD-110 LOGO	1.50
12	FG3000-410-115	SHIELD - LOWER	1.50
3	FG3000-450-151	CASE SEAL (HD SERIES ONLY)	3.10
4	FG3000-450-105	O-RING FOR INPUT JACKS	.16
5	FG3000-450-103	SCREW #4 - LONG	.16
6	FG3000-450-106	SCREW #4 - SHORT	.16
16	FG3000-420-102	SHAFT	1.00
4	FG3000-450-105	O-RING	.16
13	FG3000-420-105	KNOB, FUNCTION/RANGE SWITCH, SERIES 300	1.20
	FG3000-421-105	KNOB, FUNCTION/RANGE SWITCH, SERIES 3000	1.20
7	FG3000-980-128	SERIES 300 REAR HOUSING ASSEMBLY	7.00
	FG3000-980-129	SERIES 3000 REAR HOUSING ASSEMBLY	7.00
	FG3000-980-130	TECH 320B REAR HOUSING ASSEMBLY	7.74
	FG3000-980-131	3020B REAR HOUSING ASSEMBLY	7.74
8	FG3000-421-184	BAIL - SERIES 300	1.20
	FG3000-422-184	BAIL - SERIES 3000	1.20
	FG3000-423-184	BAIL - HD SERIES	1.85
9	FG3000-450-152	O-RING SCREW (HD SERIES ONLY)	.16
10	FG3000-450-104	SCREWS RECESSED PAN	.16
11	FG3000-980-126	BATTERY COVER ASSEMBLY - SERIES 300	2.00
	FG3000-980-127	BATTERY COVER ASSEMBLY - SERIES 3000	2.00

*Prices subject to change

ELECTRONIC ASSEMBLY

INDEX NO.	BECKMAN PART NO.	DESCRIPTION	SUGGESTED RETAIL
1	FG3000-390-100	LIQUID CRYSTAL DISPLAY	15.00
2	FG3000-450-102	SCREWS	.16
3	FG3000-420-111	CONNECTOR	1.20
3-1	FG3000-560-101	HD-100 CONNECTOR KIT	1.40
4	FG3000-370-102	CARBON ELASTOMER	1.68
5	FG3000-460-101	BEEPER	2.00
6	FG3000-420-189	CHIP CONNECTOR	1.20
7*	FG3000-370-224	GOLD ELASTOMERS (TWO)	7.30
8	FG3000-420-101	CAM	3.20
9	FG3000-270-100	MULTIPROCESSOR CHIP	18.00
10	FG3000-420-108	CHIP RETAINER	1.20
11	FG3000-421-141	RETAINER MOUNT (HD ONLY)	1.10
11-1	FG3000-420-141	BURN BEEPER MOUNT (TECH 320B, 3020B ONLY)	.80
12	FP260	FUSE 600V/2A (4 IN A BOX)	2.00
13	FG3000-450-110	SPRINT DETENT	.32
14	FG3000-410-113	LCD RETAINER KIT (SERIES 300)	3.00
	FG3000-410-114	LCD RETAINER KIT (SERIES 3000)	3.40
	FG3000-560-100	LCD RETAINER KIT (HD SERIES)	3.40

*For older meters, when you order gold elastomers (FG3000-370-224), you should order also the chip connector (FG3000-420-189). You can order both in a kit: FG3000-600-204, $8.50.



INPUT BOARD

SCHEMATIC LOCATION	REF	BECKMAN PART NO.	DESCRIPTION	QTY.	SUGGESTED RETAIL
B1,2,3	U1	FG3000-313-101	ATTENUATOR	1	21.00
A1	BR1	FG3000-211-100	BRIDGE	1	3.76
B4	C1	FG3000-131-205	CAP. .047	1	2.00
B4	C2	FG3000-191-100	CAP TRIMMER	1	5.60
A4	R1	FG3000-31-202	RES. 2K 1/2W	1	.84
B1	R2	FG3000-51-106	RES. WW 9 OHM	1	1.84
B2	R3	FG3000-71-101	RES. WW .9 OHM	1	3.44
B2	R4	FG3000-71-100	RES. WW .1 OHM	1	3.44
A5	R17	FG3000-31-241	RES. 240 1/2W	1	.80
B4	R19	FG3000-51-105	RES. WW 19.8M OHM .1%	1	9.90
	CN1	FG3000-370-146	MALE CONNECTOR FLEX	1	1.70
A3	RV1	FG3000-80-102	METAL OXIDE VARISTOR	1	5.90
A3	VR4	FG3000-231-101	ZENER DIODE	1	2.00
	FC2	FG3000-980-125	FUSE CLIP ASSEMBLY	1	5.00
B2	R4-1	FG3000-71-104	RES. WW .0898 OHM	1	2.30
	SB1	FG3000-420-100	SWITCH BLOCK	1	9.60
	FC1	FG3000-370-107	FUSE CLIP ASSEMBLY	2	.96
A2	R18	FG3000-040-101	SHUNT .01 OHM	1	3.50
A4	R1-1	FG3000-001-202	RES. 2K 1/4W	1	.64

FIGURE A

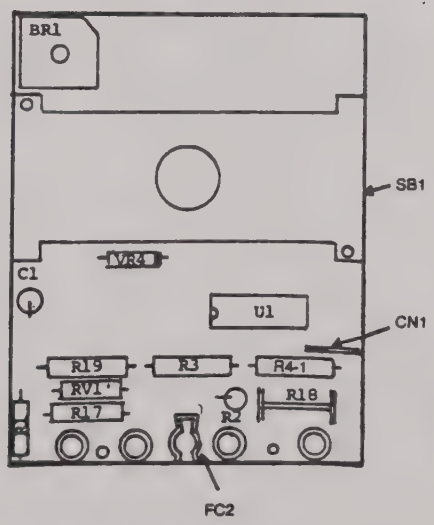
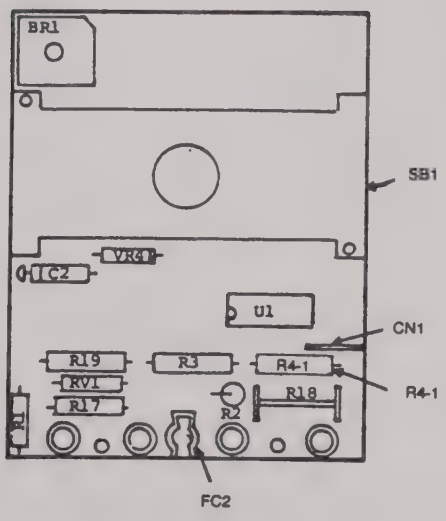


FIGURE B



INPUT BOARD

FIGURE S

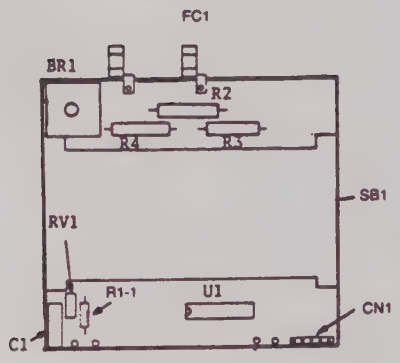


FIGURE T

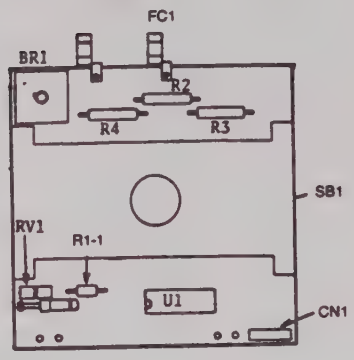


FIGURE N

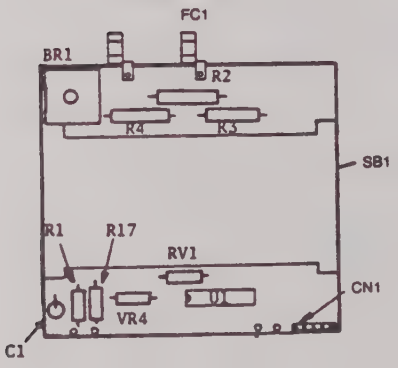


FIGURE M

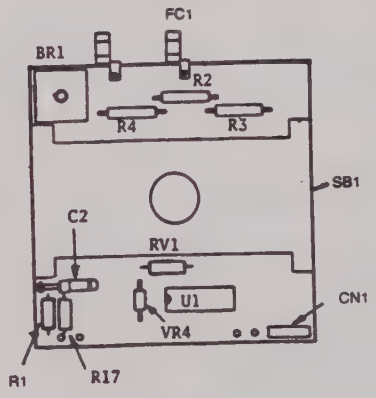


FIGURE C

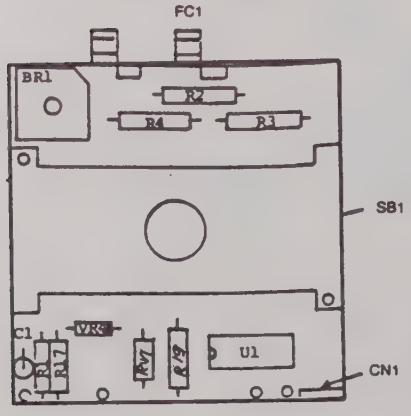
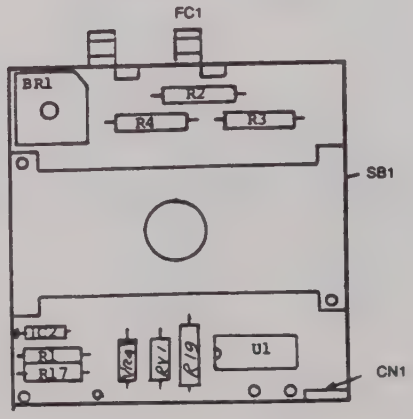


FIGURE D



DISPLAY BOARD

SCHEMATIC LOCATION	REF	BECKMAN PART NO.	DESCRIPTION	QTY.	SUGGESTED RETAIL
	SB1	FG3000-420-100	SWITCH BLOCK	1	9.60
G2	U2	FG3000-310-100	REF.DIVIDER THIN FILM	1	3.66
F5	U3	FG3000-300-100	RES.NETWORK,10 PIN SIP	1	2.16
F6	U8	FG3000-270-104	IC CD 4030	1	1.76
D3	U5	FG3000-300-102	RES. NETWORK,8 PIN SIP	1	1.80
G4	U6	FG3000-270-102	INT. CIR. HEX INV. 4069	1	1.92
D3	U7	FG3000-270-101	INT. CIR. RMS CONVERTER	1	26.90
D3	Q3,4	FG3000-251-100	TRANS. PNP-G.P.-2N4126	2	1.30
F5	Q1	FG3000-251-101	TRANS. NPN G.P.-2N5088	1	.84
F5	Q2	FG3000-251-102	TRANS. NPN, DARL.MPSA12	1	.84
I5,F4,G4 G6, F6	CR1,2 CR3,4,5	FG3000-201-100	DIODE, SMALL SIGNAL		.96
C2,E5	VR2,3	FG3000-231-101	DIODE,ZENER LOW LEAKAGE	5	2.00
F1	VR1	FG3000-231-102	DIODE, REF. 1.2V	2	3.54
F6	R16	FG3000-1-474	RES. 470 K OHM	1	.32
E3	R14	FG3000-90-102	RES. VAR. 500 OHM +10%	1	2.00
D3	R13	FG3000-90-103	RES. VAR. 5 M OHM +20%	1	2.00
D3	R12	FG3000-1-120	RES. 12 OHM +5%, 1/4W	1	.32
D4	R11	FG3000-1-165	RES. 1.6M OHM 5%,1/4W	1	.32
F6	R15	FG3000-1-104	RES. 100 K OHM, 1/4W	1	.80
F5	R6	FG3000-1-241	RES. 240 OHM, 1/4W	1	.80
I1	R7	FG3000-1-474	RES. 470 K OHM, 1/4W	1	.32
C4	R9	FG3000-51-101	RES. 200 K OHM, 3W	1	1.30
G3	R8	FG3000-51-102	RES. 2 M OHM, 3W	1	1.30
E5	R10	FG3000-82-103	RES. POS. TC,750 OHM	1	3.76
G2	R5	FG3000-90-101	POTENTIOMETER, 10 K OHM	1	2.00
	BT1	FG3000-370-176	BEEPER TERMINAL	1	.60
	CN2	FG3000-370-144	FEMALE CONNECTOR 5-PIN	1	.80
H1,E3	C10,13	FG3000-101-100	CAP. 470PF DISC CERAMIC	3	.48
G5	C16				
G4,G6	C2,5,19	FG3000-111-100	CAP. .22 uF/25V MIN.CER.	4	1.44
F6	C20				
G3,G1	C8,9	FG3000-130-102	CAP. .22 uF,100V,MYLAR	2	1.44
G2	C6	FG3000-130-101	CAP. .022 uF,250v,MYLAR	1	.72
G3,G2	C4,7	FG3000-130-100	CAP. .047 uF,250V,MYLAR	2	1.10
E3	C12	FG3000-151-100	CAP. 3.3 uF,20v MIN TAN	1	2.00
D3,F3	C3,25	FG3000-151-101	CAP. 10 uF/10V MIN,TAN	2	2.08
I5	C11	FG3000-161-100	CAP. 10uF, ELECTROLYTIC	1	1.10
D3,E3	C14,15	FG3000-101-101	CAP. 33pf,DISC CERAMIC	1	.72
C3	C18	FG3000-101-102	CAP. 4.7 pf DISC CERAMIC	1	.80
C3	C17	FG3000-151-102	CAP. 47 uf/6v MIN, TAN.	1	3.40

FIGURE R&P
DISPLAY BOARD—NON-RMS

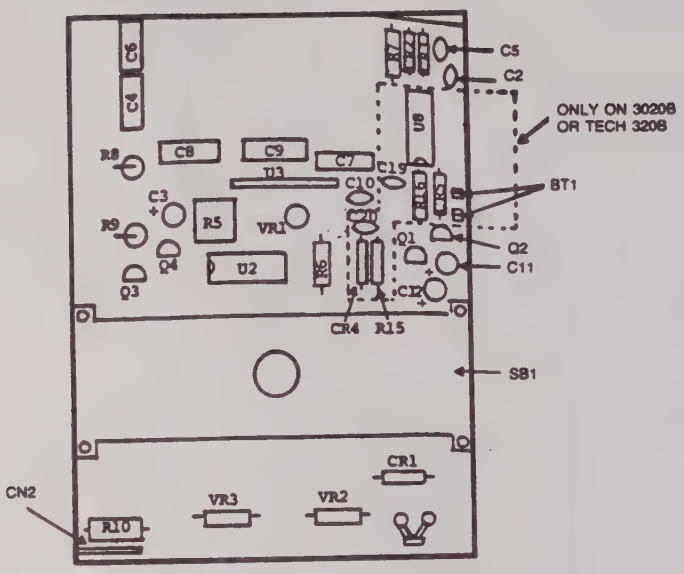


FIGURE Z
DISPLAY BOARD—RMS

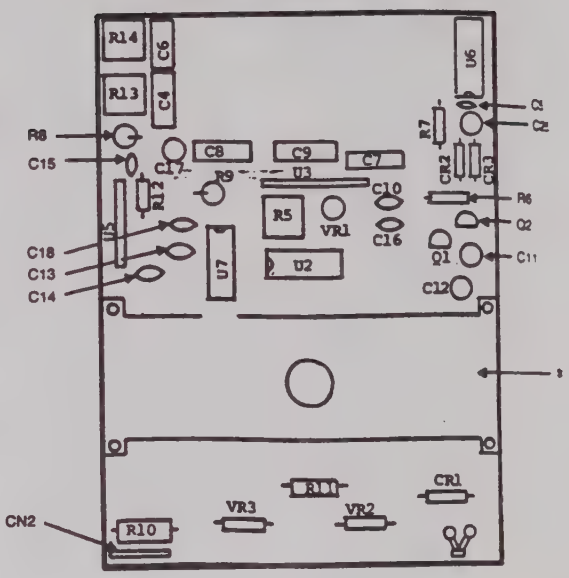


FIGURE W
DISPLAY BOARD—NON-RMS

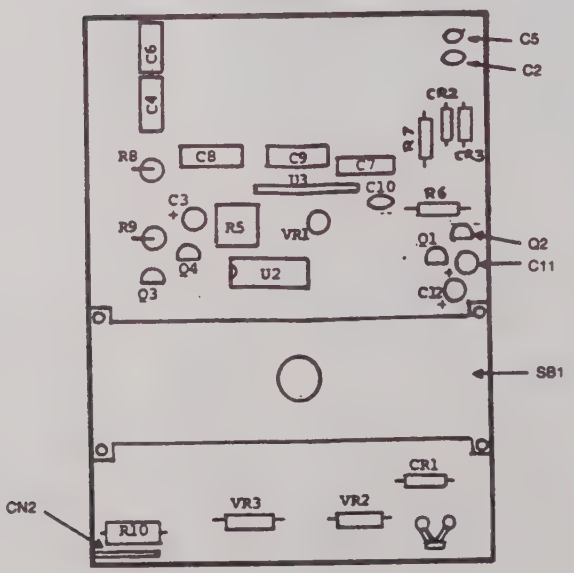
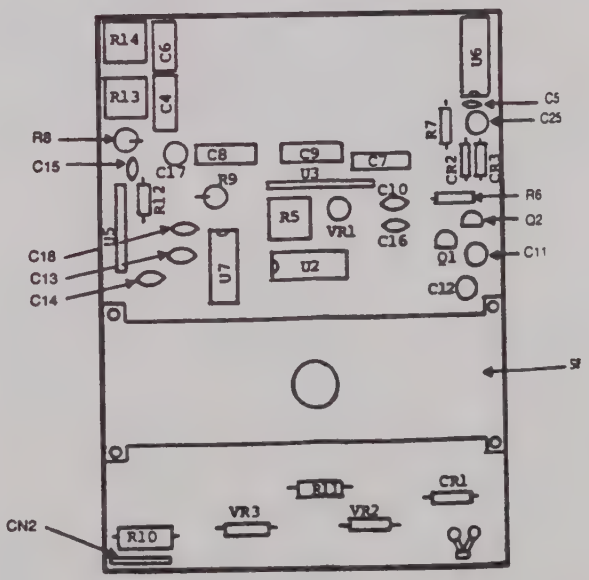


FIGURE X
DISPLAY BOARD—RMS



BECKMAN DIGITAL MULTIMETER SERVICE CENTERS--U.S./CANADA

Please note that all authorized service centers are NOT REQUIRED to abide by the factory flat fee policy. Please contact each center for estimates.

CALIFORNIA - SO.

Metermaster
5646 Jillson Street
Los Angeles, CA 90040
(213) 685-4340

Shafer Engineering
333 North Santa Anita, #7
Arcadia, CA 91006
(213) 795-5000

CALIFORNIA - NO.

Standard Meter Labs
11815 Dublin Boulevard
Dublin, CA 94566
(415) 828-4837

COLORADO

Barnhill Associates
7076 South Alton Way, Building A
Englewood, CO 80112
(303) 779-3600

Instrument Repair Labs
1728 - 16th Street
Boulder, CO 80302
(303) 449-2721

D.H. Crump & Co.
6340 West Mississippi
Lakewood, CO 80226
(303) 936-4407

GEORGIA

Process Measurement Company
4509 Fulton Industrial, S.W.
Atlanta, GA 30336
(404) 696-7481

ILLINOIS

Metermaster
121 Gordon Street
Elk Grove Village, IL 60007
(312) 593-8650

INDIANA

Electro-Lab Services, Inc.
1302 North Fulton Avenue
Evansville, IN 47712
(812) 423-5211

LOUISIANA

Industrial Instrument Works, Inc.
5745 Salmen Avenue
Harahan, LA 70123
(504) 733-8355

MARYLAND

EIL Instruments, Inc.
10 Loveton Circle
Sparks, MD 21152
(301) 771-4800

MASSACHUSETTS

AST Servo Systems
20 Republic Road
North Billerica, MA 01862
(617) 667-8541

EIL Instruments, Inc.
21 "A" Street
Burlington, MA 01803
(617) 272-9450

MINNESOTA

Instrumentation Services, Inc.
957 Winnetka Avenue North
Minneapolis, MN 55427
(612) 544-8916

MISSOURI

Industrial Service Laboratories Corp.
4354 Olive Street
St. Louis, MO 63108
(314) 535-5760

NEW YORK

Electronic Instrument Co.
85 Avenue E
Rochester, NY 14621
(716) 544-4392

Trott Electronics
9020 Wehrle Drive
Clarence, NY 14031
(716) 634-8500

The Instrument Mart
295 Community Drive
Great Neck, NY 11021
(516) 487-7430

NORTH CAROLINA

Metermetrics
5821 North Boulevard
Raleigh, NC 27604
(919) 872-5456

OHIO

Unitek Instruments
5919 Karl Road
Columbus, OH 43229
(614) 885-6703

OKLAHOMA

Central Instrument Labs
4673 South 83rd East Avenue
Tulsa, OK 74145
(918) 622-1140

OREGON

Westcon, Inc.
5101 North Interstate Avenue
Portland, OR 97217
(503) 283-0132

PENNSYLVANIA

Sunshine Scientific Instruments
1810 Grant Avenue
Philadelphia, PA 19115
(215) 673-5600

TEXAS

Dallas Meter-Tek Supply
10209 Plano Road
Dallas, TX 75238
(214) 349-6044

EIL Instruments, Inc.
7385 Ashcroft Street
Houston, TX 77081
(713) 271-3100

Metermaster
2809 National Drive
Garland, TX 75041
(214) 271-5671

Meters & Instruments Corporation
6428 Gulf Freeway
Houston, TX 70023
(713) 644-1631

VIRGINIA

Instrument Technical Reps
7400 Whitepine Road
Richmond, VA 23227
(804) 275-1431

WASHINGTON

EIL Instruments
1312 South 96th Street
Seattle, WA 98108
(206) 762-0880

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For warranty and non-warranty repair service, please contact the following service centers.

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Vancouver V6X 2S3
(604) 324-3633

MANITOBA

Probe Industrial Electronics
1874 Portage Avenue
Winnipeg, Manitoba R3J OH2
(204) 885-9320

ALBERTA

Kingsway Aviation & Industrial Instruments Ltd.
4238 - 91A Street
Edmonton T65 5V2
(403) 463-5264

ONTARIO

BCS Electronics
980 Alness Street, Unit 7
Downsview M3J 2S2
(416) 661-5585

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Montreal H2G 1A1
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